Before the Secretary of Commerce

Petition to List the Southern Eulachon (Thaleichthys pacificus) Distinct Population Segment as Threatened or Endangered Under the Federal Endangered Species Act

November 9, 2007

Submitted By:

The Cowlitz Indian Tribe

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Signature Date

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COWLITZ INDIAN TRIBE

November 9, 2007

Secretary Carlos M. Gutierrez
United States Department of Commerce
1401 Constitution Avenue, NW
Washington, D.C. 20230

Re: Petition to list southern eulachon as a threatened or endangered species

Dear Secretary Gutierrez:

The enclosed petition requests that the National Oceanic and Atmospheric Administration Fisheries Service, Department of Commerce, review the status of eulachon (*Thaleichthys pacificus*) that spawn in U.S. rivers south of the international border with Canada, and based on such findings, list this Distinct Population Segment (DPS) as threatened or endangered under the federal Endangered Species Act (16 U.S.C. §§ 1531-1534). This petition details the evidence for delineating the southern eulachon DPS according to the Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act (Federal Register, February 7, 1996, 61(26) p.4722-4725) and summarizes the best available scientific and commercial information regarding the severely depleted status of this DPS.

Respectfully,

John Barnett

The Honorable John Barnett
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Executive Summary

With this petition, the Cowlitz Indian Tribe hereby requests that the National Marine Fisheries Service (NMFS)[1] designate populations of eulachon (*Thaleichthys pacificus*) that spawn in rivers that drain to the eastern Pacific Ocean south of the international border of the United States and Canada as a Distinct Population Segment (DPS). The Tribe requests further that the Secretary of Commerce list these populations, referred to in aggregate as the Southern Eulachon DPS, as threatened or endangered pursuant to the federal Endangered Species Act 16 U.S.C. §§ 1531-1534.

Eulachon, also known as candlefish, oolichan or smelt, are an anadromous species that are endemic to the eastern Pacific region. Historically, eulachon spawned in medium-to-larger sized rivers ranging from central California to southwest Alaska. Adult eulachon typically return from the ocean to spawn during the winter and early spring. Eulachon normally, but not always, spawn in the river systems in which they were born. The large majority of fish die after spawning. After hatching, eulachon larvae are carried by river currents to the estuary and ocean where they spend between 3 to 5 years, on average, before migrating back to freshwater to spawn. The species is an important component in marine and freshwater ecosystems, where they feed primarily on zooplankton and are preyed upon, in turn, by higher order predators such as marine mammals, salmon, sturgeon, and numerous species of birds. Eulachon have long been important both ecologically and culturally to aboriginal peoples, including the Cowlitz Indian Tribe, that have lived along the west coast of North America for thousands of years. Eulachon have also been an important food resource for non-Indians since they began settling in the Pacific Northwest over 200 years ago; for most of the time since then, eulachon in the Columbia and Fraser Rivers have supported large commercial and recreational fisheries.

This petition summarizes information that can be used to discern the structure and distribution of eulachon populations for the purposes of conducting an ESA status review and making a listing determination. Following guidance presented in the joint DPS policy published in 1996 by the U.S. Fish and Wildlife Service and NMFS, we present information and rationale to support the contention that eulachon populations that spawn in Washington, Oregon and California rivers meet both the "discreteness" and "significance" criteria of the policy, and therefore warrant designation as a single DPS.

It should be noted that evidence for differentiation between Columbia and Fraser River eulachon populations is inconclusive. A recent genetics study indicates that the two eulachon populations are more closely related to one another than they are to more northerly populations. However, the same study reported statistically significant genetic differences between the two populations at a finer scale that may be meaningful from both a biological and conservation perspective. Based on our review of this and other scientific evidence, we conclude that the loss of either the Columbia or Fraser River eulachon populations would imperil the persistence of the taxon, regardless of the relationship or role played by eulachon populations from other, smaller river systems. Due to differences

[1] NOAA Fisheries Service, U.S. Department of Commerce

between the U.S. and Canada in the management and regulation of eulachon harvest and habitat, and lacking concrete evidence for further differentiation among individual populations that spawn in river systems located south of the international border, we recommend that NMFS classify these populations as a single, discrete group of populations, separate from those occurring further north, including the Fraser River. Further, because the loss of these Washington, Oregon and California populations of eulachon, in toto, would pose a significant risk to the long-term persistence of the species, we recommend that they be designated as a DPS, which we refer to as the Southern Eulachon DPS. This designation is consistent with the best available scientific data and with the Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act (FR February 7, 1996 Vol. 61, p. 4722).

Prior efforts to list Columbia River eulachon as a threatened or endangered species were ultimately rejected by NMFS because the population under consideration was not clearly defined, and because available data were deemed to be inconclusive regarding the risk of extinction. In reviewing this petition, should NMFS determine that the eulachon population structure we recommend is inconsistent with the facts, we encourage the agency to consider alternative DPS designations based on an independent review and application of DPS criteria to available data.

Most, if not all, of the eulachon populations comprising the Southern Eulachon DPS have declined significantly in the past decade. The steep decline observed over the recent past accentuates a gradual, if somewhat variable, downward trend in abundance that occurred in the previous several decades. In some river systems, such as the Sacramento and Klamath Rivers in northern California, the number of eulachon returning to spawn has declined to undetectable levels. Although eulachon do not always spawn in the same river from one year to the next, and therefore are difficult to enumerate, their prolonged absence in recent years in several rivers where, until recently, they consistently returned to spawn in large numbers, suggests that the recent coastwide decline in eulachon abundance is both significant and non-transitory. As discussed in the petition, the best available scientific evidence overwhelmingly supports this claim.

While the reasons for the decline in eulachon abundance are not known exactly, the species' anadromous life history and exploited status render it exceedingly vulnerable to several of the statutory factors described in the ESA Sec. 4(a)1, viz destruction or modification of habitat, overutilization, predation, inadequate regulatory mechanisms, and other natural and manmade factors.

Regardless of the ultimate DPS designation, this petition presents evidence that clearly indicates that eulachon in the Columbia River and other river systems south of the U.S.–Canada border are likely to go extinct in the near future unless steps are taken to ameliorate factors that threaten their existence and restore them to viable levels. We therefore request that NMFS accept this petition as a prelude to conducting a formal review of the species' status.

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Petitioner

For millennia, the Cowlitz Indian Tribe inhabited a large area of what is now referred to as southwest Washington State. Comprising the Taidnapam (Upper Cowlitz) and Kawlic (Lower Cowlitz) bands, people of our Tribe reside principally in the Cowlitz, Toutle, Kalama and Lewis River drainage basins. We were one of the tribes to make contact with Meriwether Lewis and William Clark when their party reached the Pacific coast in the winter of 1805. That winter, Lewis and Clark sent an expedition from Fort Clatsop to the Cowlitz River to gather smelt and they returned with a boat load of these fish. When Governor Stevens of Washington Territory extended a treaty offer from the United States government in 1855, the Cowlitz elected not to sign it. In the years since, we have maintained our communal and cultural integrity (National Indian Gaming Commission, Office of General Counsel, 2005). Consequently, the U.S. Department of Interior formally recognized the Cowlitz Indian Tribe as a sovereign government on February 14th, 2000; our status as a Tribe was reaffirmed on January 4, 2002 (67 FR 607).

The well-documented myths and traditions of our Tribe underscore the cultural and ecological importance of eulachon to our people, and suggest that the species was historically much more abundant than it is today. Eulachon spawn in late winter and therefore served as a critical food source when other resources were in short supply. Eulachon were traditionally harvested with weirs, nets, baskets and, when spawning runs were at their peak, by simply raking the fish from the river. As one of the "fish-eating tribes", our quality of life and continued existence depend in large part on our ability to harvest and consume fish. Unfortunately, the populations of eulachon, lamprey, salmon and trout that historically sustained the Tribe have declined to a vestige of their former abundance. If the Cowlitz Tribe is to maintain its cultural and spiritual integrity, we must have access to the species and resources upon which we traditionally relied in the past. For these reasons, it is essential that the Columbia River eulachon population be restored to healthy, harvestable levels of abundance. Because the prospect of eulachon becoming extinct is wholly unacceptable to us, we are asking the Secretary of Commerce to list eulachon as a threatened or endangered species under the ESA.[2]

Introduction

This petition compiles and analyzes the best available scientific and commercial data on eulachon (*Thaleichthys pacificus*, Richardson 1836), and based on this information, argues that populations of this species inhabiting areas south of the international border between the United States and Canada qualify as a Distinct Population Segment (DPS), and that the persistence of this DPS, or of a similar population aggregate warranting designation as a DPS, is sufficiently threatened to warrant listing as a threatened or endangered species pursuant to the federal Endangered Species Act 16 U.S.C. §§ 1531-1534.

[2] This petition was prepared with the assistance of fisheries scientists from Steward and Associates, a fisheries and aquatic science consulting firm located in Snohomish, Washington. Questions regarding its technical content should be directed to either Cleve Steward (csteward@stewardandassociates) or Tad Schwager (tschwager@stewardandassociates) at Tel. 360-862-1255.

In presenting our case for a eulachon listing, we have attempted to limit ourselves to relevant data and analyses and the inferences that can be drawn from them. More detailed information on the taxonomy, ecology and historical significance of eulachon than is presented here can be found in previously published work by Wilson et al. (2006), Larson and Belchik (1998), Hay and McCarter (2000), and others.

Natural History

Distribution

Eulachon are an anadromous smelt of the family Osmeridae, and are endemic to the northeast Pacific. Historically, eulachon ranged from northern California to southwest Alaska (Minckley et al. 1986) and into the southeastern Bering Sea (Hay and McCarter 2000). Spawning runs occur primarily in the lower reaches of larger, snowmelt-fed rivers where spring freshets are predictable. Eulachon have been known to spawn in other, smaller, coastal systems that drain lowland areas, but their use of these systems is believed to be irregular and demographically inconsequential in comparison to the larger runs. Wilson et al. (2006) recently reviewed the scientific and anecdotal sources describing the freshwater and marine distribution of this species along the west coast of North America.

In the portion of its range that lies south of the U.S.–Canada border, most eulachon production originates in the Columbia River Basin. Within the basin, eulachon spawn in the mainstem Columbia River above the upper extent of saltwater intrusion (approximately River Mile 23) and below the Bonneville Dam (River Mile 146.1), and in the lower reaches of several tributaries thereto: the Grays, Skamokawa, Elochoman, Cowlitz, Kalama, Lewis, and Sandy Rivers (WDFW and ODFW 2001). Of these tributaries, the Cowlitz River is conspicuous for the number of eulachon it produced over the past century – a number that prompted the City of Kelso to call itself "Smelt Capital of the World" for several decades (Hinrichsen 1998). Smelt occasionally migrated as far upstream as the Hood River before Bonneville dam was constructed in 1936 (Smith and Saalfeld 1955).

South of the Columbia River mouth, eulachon have been identified in very few coastal streams. Observations of adult eulachon have been reported from the Umpqua and Rogue rivers, Oregon, (Emmett et al. 1991, Musick et al. 2000) but the assertion that these individuals represent spawning runs has been strongly refuted (Wright 1999). Historically, eulachon were abundant in northern California's Klamath River where they supported a tribal fishery (Larson and Belchik 2000). Eulachon have also been reported in Humboldt Bay (Jennings 1996), Mad River, Redwood Creek (Moyle 1976), Russian River (Odemar 1964) and the Sacramento River (Minckley et al. 1986).

Eulachon are uncommon in rivers draining to Puget Sound or Hood Canal in Washington, but have been observed, albeit infrequently, in several rivers along the Washington coast, such as the Bear, Naselle, Nemah, Wynoochee, Quinault, Queets, Nooksack (Emmett et al. 1991, WDFW and ODFW 2001). They have also been reported to spawn in the Elwha River on the Strait of Juan de Fuca (Shaffer et al. 2007). These runs are irregular and likely represent straying in response to anomalous environmental conditions. For example, in 1993 cold water temperatures in the Columbia delayed the spawning run, while at the same time eulachon were noticed in nearby coastal Washington rivers (Wright 1999).

Eulachon production in British Columbia has been documented in 33 rivers, but only in roughly half of these on a sustained basis. The major provincial river systems used by eulachon are the Fraser, Skeena, Nass, and Klinaklini, with the Fraser historically reporting the most abundant runs (Hay and McCarter 2000).

Life History

Eulachon are anadromous, spending the great majority of their lives in the ocean but returning to freshwater to spawn. They are generally considered semelparous, that is, spawning once before dying, although some degree of iteroparity may exist. In the Columbia River tributaries, spawning occurs over coarse sand or gravel substrates in the winter and early spring when water temperatures are between 4° and 10° C. Eggs are fertilized in the water column and slowly sink as they drift downstream and eventually adhere to the substrate. After incubating for 30-40 days, depending on ambient water temperatures, the eggs hatch and the larvae drift out to the estuary and ocean where they spend from 2 up to 9 years, but typically 3 to 5 years, before migrating back to freshwater to spawn.

The ecology of larval eulachon bears important similarities to that of young salmonids. Both species imprint the chemical signature of their natal streams before or during outmigration, which allows them to relocate those areas when they return as adults to spawn (Hay and McCarter 2000). Eulachon, however, spend far less time in freshwater than do juvenile salmonids; after incubating for a few weeks, larval eulachon hatch and drift immediately out to the estuary, usually within hours. Estuarine currents may entrain larvae for a few days, but strong tidal fluctuations usually assure rapid, thorough mixing and dispersal. As a result, eulachon probably do not imprint strongly and thus have higher stray rates than salmonids. Based on observations of the behavior of returning smelt, it is believed that they home to their ocean entry point, and then select specific rivers and spawning areas based on environmental conditions at that time (Hay and Beacham 2005).

Prior Petition and Findings

Concern about unprecedented declines in the Columbia River eulachon run has been raised before. In 1999, retired Washington Department of Fish and Wildlife biologist Sam Wright submitted a petition to list Columbia River eulachon under the Endangered Species Act (Wright 1999). The data and many of the arguments presented in that petition remain valid today. This petition makes reference to those data and arguments, but primarily focuses on new information that has become available since 1999. This new information offers further insight into eulachon population structure and reinforces the claim that populations in the southern portion of their range are severely depleted and, in some cases, no longer exist.

In his petition, Wright (1999) defined the population unit as the Columbia River eulachon and noted "an unprecedented seven year decline in resource abundance from 1993 through 1999," as indicated by commercial catch records dating back to 1895. Wright also presented other qualitative and anecdotal supporting information, such as regarding historical fisheries, fishing effort, alterations to habitat, and the role of the species within the ecosystem.

In the 90-day response, NMFS determined that the petition, along with other scientific and commercial information available at the time, did not warrant a formal review (NMFS 1999). Three reasons were given for this finding. First, not enough information was available to distinguish the Columbia River eulachon as a DPS. Second, harvest data did not provide a reliable indicator of abundance. Third the extent to which eulachon spawn outside of the Columbia River Basin is unknown. The 90-day finding also states that the species, "has a demonstrated ability to rebound from periods of low abundance," and that, "ocean conditions are probably the most important factor controlling eulachon abundance."

In a rebuttal to the 90-day response, Wright (2000) presented information that appeared to weaken or refute the arguments used to support NMFS' decision, and asked the agency to reconsider its finding. There is no evidence that this request was officially addressed; therefore, the primary points raised by Wright (2000) are summarized here.

First, in its finding NMFS stated that, "there are potentially numerous streams – within and outside the Columbia basin – that are unsurveyed but still used by spawning eulachon," citing Emmett et al. (1991). The validity of this claim was questioned by the petitioner in his rebuttal because of the qualitative nature of the information and the potentially misleading terminology used to describe eulachon occurrences in coastal estuaries. Wright argued further that the occurrence of eulachon in Washington coastal streams does not necessarily represent persistent spawning runs.

Second, Wright believed that NMFS misinterpreted Columbia River eulachon catch data with respect to the distribution and past abundances. For example there is disagreement regarding inferences based on observations of zero catches over multiple years in several different tributaries. In the 90-day finding, NMFS noted that the catch history from each tributary showed several years, often consecutive and longer than the typical life-span of eulachon, where no catch had been recorded. Often these periods were immediately followed by record high returns. The NMFS asserted that "catches of zero fish are not necessarily indicative of a population that, as asserted by the petitioner, has 'no reasonable expectation of being able to recover.'" This observation could have represented a valid argument if eulachon homing abilities were assumed to be as accurate as salmonids, and if the petition had been considering only each individual tributary as population units. However, this claim is contrary to the best scientific evidence regarding stray rates and ignores the level of population distinction defined in the original petition. In his rebuttal, Wright (2000) pointed out that, even though the distribution of tributary spawning has been inconsistent, the total returns to the Columbia River Basin as a whole (including spawning in the mainstem) have always been much larger than current levels.

In the 90-day response, NMFS also debased the usefulness of catch statistics to indicate relative historic abundances, citing results from larval surveys that revealed eulachon spawning activity in tributaries where none had been caught, and concluded that the available data were not convincing enough to warrant a full status review. The petitioner rebutted that this conclusion missed the main point, namely that even though these metrics are not perfectly correlated with run sizes, they probably underestimate the historic high periods of abundance and overestimate historic and current low periods of abundance, which reinforces, rather than refutes, the argument that this species is at risk. In other words, in years when eulachon runs were strong, fishermen had no problem filling the market demand, which led to a reduction in the price per pound and thus less motivation to harvest more smelt. In these years, catch values probably represented a small proportion of the total run size because harvest was curtailed. In contrast, the price per pound was higher during years when fishermen had more difficulty meeting market demand, due to small run sizes. The increased fishing effort in response to higher prices likely meant that the catch values represented a larger proportion of the total run size and thus a higher fishing mortality rate.

Delineation of Southern Eulachon DPS

Service Agencies' DPS Policy

In 1996, the United States Fish and Wildlife Service (USFWS) and NMFS clarified their interpretation of the DPS provision of the ESA (section 3(15)). The resulting joint DPS policy (USFWS and NMFS 1996) identified two elements that must be considered when making DPS determinations; they are repeated verbatim here:

1. the discreteness of the population segment in relation to the remainder of the species (or subspecies) to which it belongs, and

2. the significance of the population segment to the remainder of the species (or subspecies) to which it belongs.

Under the joint DPS policy, the discreteness criterion must be met before the significance criterion is evaluated. The policy identifies a number of conditions (discussed further below) that, if met, would satisfy either criterion. If a population can be shown to be discrete and significant, it qualifies as a DPS. Its status is then determined for the purposes of listing, delisting, and reclassifying a species under the ESA (51 FR 4722). In this section we explain the rationale used to define the Southern Eulachon DPS.

Discreteness of DPS

A population segment may be considered discrete if it satisfies either one of the following conditions: (1) it is markedly separated from other populations of the same biological taxon as a consequence of physical, physiological, ecological, or behavioral factors (quantitative measures of genetic or morphological discontinuity may provide evidence of this separation); or (2) it is delimited by international governmental boundaries across which there is a significant difference in exploitation control, habitat management or conservation status.

Although the record is sparse, several studies have attempted to differentiate eulachon populations throughout their range (Hay and Beacham 2005). Based on various investigative techniques, studies have obtained the following results:

- Run timing and other life history traits – Eulachon spawning runs occur at different times throughout their range. In general, run timing is not well correlated with latitude as would be expected if spawning migration were a purely physiological response to warming temperatures and/or snow melt. For example, in the Columbia River and further south, eulachon spawn early, usually beginning in late January or February, but in the Fraser River, spawning begins much later in April or May (Hay and McCarter 2000). Northern BC rivers (Nass and Skeena) have early runs that begin in late February or early March, while Alaskan rivers support runs later in May (Hay and McCarter). These differences in run timing reflect stock differences and/or provide a mechanism for population segregation.

- Meristic differences – The mean number of vertebrae are significantly different among eulachon groups from different regions (Hart and McHugh 1944, Hay and McCarter 2000). This variation may be environmentally induced during development but does not change over the life of the individual. Therefore, while this statistic does not necessarily represent a phenotypic characteristic, it does serve as a type of mark to identify groups of individuals from common origins. The preservation of these differences among groups suggests it is unlikely that eulachon throughout their range are a pan-mictic stock as previously believed. Instead, homing tendencies are apparent and represent another mechanism for population separation.

- Distributions of larvae – Larval eulachon from different sources can overlap and mix in areas where several different rivers feed into the same estuary or nearshore area (Hay and McCarter 1997). This has important implications for population differentiation because if the imprinting (of the specific chemical signatures that forms the basis for homing) occurs in the larval stage, as it does in salmon, then eulachon would only be capable of homing to the estuarine waters, and not to specific rivers. This has been postulated for areas in BC, such as Douglas, Gardner, and Dean Channel, and may apply to the Columbia River.

- Genetic markers – The first genetic work on eulachon, using mitochondrial DNA, did not identify significant differences between fish collected from 11 freshwater locations from the Columbia River to the Bering Sea (McLean et al. 1999), but did provide evidence to support the isolation-by-distance hypothesis. Follow up research using microsatellite DNA from the same samples (McLean and Taylor 2001) revealed more significant pairwise comparisons, but did not support the isolation-by-distance theory. Both articles describe results in relation to a recent post-glacial dispersal from a single refuge (in the Columbia River) during the

Wisconsinan period. Recent genetic work (Beacham et al. 2005) using 14 microsatellite loci instead of 5 has effectively revised the conclusions made in prior genetic studies and confirmed the differences between eulachon populations that had been identified using other techniques. Pairwise F_{ST} values averaged over the 14 loci were significantly different between almost all of the groups. More substantial differentiation was observed at the regional scale. For example, in a bootstrap approach used to create a dendrogram based on the Cavalli-Sforza and Edwards (1967) chord distances, Fraser, Columbia and Cowlitz populations clustered together 97% of the time.

Both genetic and non-genetic techniques reveal differences that are contrary to the hypothesis that eulachon are a single, coastwide population. Although their ability to home to specific rivers may not be as precise as salmon, eulachon appear to display sufficient fidelity to their natal spawning and rearing areas to maintain the observed genetic, meristic, and life-history related differences noted among populations from different areas. Thus, taken as a whole the best available scientific evidence shows significant differentiation between eulachon throughout their range and the smallest stock unit is most likely the ocean entry point, or estuary of spawning rivers (Hay and McCarter 2000, Beacham et al. 2005).

Unfortunately, the results of Beacham et al. (2005) did not include samples from any other areas that became delineated in their report as the Southern stock. We highly recommend follow up genetic work to identify any genetic differences between eulachon that spawn in different tributaries of the Columbia River and in coastal streams. In the meantime, the best available science indicates that the Fraser River, Columbia River mainstem and the Cowlitz River are distinct from each other, but are more closely related to one another than they are to more northerly populations. Eulachon abundances in the Fraser and Columbia prior to the early 1990s, as indicated by catch statistics, show no correlation. However, both of these populations experienced substantial declines in abundance in the early 1990s and neither have fully recovered. Considering the genetic and other life-history differences, this recent covariation is likely an artifact of changing ocean conditions that have exerted a dampening effect on eulachon survival and productivity over a large area, and not necessarily indicative of a single, large population. Furthermore, juvenile eulachon from the Fraser and Columbia Rivers mix during the marine life stage off of the central and south west coast of Vancouver Island and thereby experience similar sources of mortality over a significant portion of their lives.

Regarding eulachon observed in other river systems, it seems likely that larger, geographically distant river systems such as the Sacramento and Klamath River systems in California support, or did support until recently, discrete, locally adapted populations of eulachon. It seems less probable that smaller coastal rivers support distinct populations, since eulachon production from these systems is sporadic and probably influenced by strays from the larger rivers systems. However, these conclusions will remain conjectural until additional research is conducted to clarify relationships among eulachon populations that spawn in different locations.

International Boundary

According the DPS policy (USFWS and NMFW 1996), a population segment "may be considered discrete if it… is delimited by international government boundaries." Although eulachon from the Fraser and Columbia Rivers may be genetically similar and distinct from more northerly populations, they occur in jurisdictions that have significantly different harvest and habitat management regimes. While the sharp downward trend in Columbia River eulachon abundance during the last 15 years has been mirrored by a similar collapse of the Fraser River eulachon population, Canada manages its own eulachon fisheries independently and differently from the U.S. The two countries differ in their regulatory control of commercial, recreational and tribal eulachon harvest, and in their management of factors affecting eulachon habitat. Based on these differences, there is no assurance that the U.S. and Canada will coordinate management and regulatory efforts sufficiently to conserve eulachon and their habitat. We therefore request that NMFS consider the northern extent of the Southern Eulachon DPS as delimited by the United States-Canada border between Washington and British Columbia.

Significance of DPS

When viewed from social, economic and ecological perspectives, eulachon are unquestionably significant. The recent precipitous decline of eulachon has caused major perturbations in each of these areas; their loss would cause further significant and potentially irreversible changes.

For generations of Indians across the entire Pacific Northwest Coast, eulachon have been an important food source due to their high oil content, nutritional value, and season of arrival. Moreover, eulachon oil has the unique property of being a solid at room temperature, with the consistency and color of butter. Traditional Tribal practices of oil rendering allowed the hard fat to be transported and stored in bentwood cedar boxes, which became an important economic trade commodity among interior and coastal tribes. Recent research (Byram and Lewis 2001) reveals that the modern place name *Oregon* may have been derived from a Cree Indian pronunciation of the word o*oligan*, the aboriginal name of the fish and the source for the modern word *eulachon*. As mapped, the river of *Ourigan* may have initially meant the Fraser River of Vancouver B.C., but the name, first spelled as Oregon in 1778 by Jonathan Carver, was broadly used to denote the entire region.

The virtues of eulachon were also appreciated by early non-Indian visitors to the west coast. In 1806, Meriwether Lewis described,

> "…a species of small fish which now begin to run, and are taken in great quantities in the Columbia R. about 40 miles above us by means of skimming or scooping nets . . . I find them best when cooked in Indian stile, which is by roasting a number of them together on a wooden spit without any previous preparation whatever. They are so fat they require no additional sauce, and I think them superior to any fish I ever taste, even more delicate and luscious than the white fish of the lakes which

> hae heretofore formed my standaart of excellence among the fishes."
> (February 25, 1806)

Eulachon play an important role in marine and riverine ecosystems as a rich and abundant food source for marine mammals, birds, and fish. Their high energy density (higher than even other forage fish such as herring, capelin, and sand lance) and run timing make them particularly important for Columbia River sturgeon during the late-winter (reviewed in Wilson et al. 2006). In fact, the primary use for eulachon today is bait for sturgeon fishing, for which eulachon can demand a substantial price per pound.

The number of eulachon that historically spawned in the Columbia River and its tributaries was larger than any other population within the species' range, primarily reflecting the large size and productivity of the river. Fishery landings in the Columbia River Basin, recorded since the late 1800s, have been almost an order of magnitude larger than in the Fraser, which is the next largest fishery (Hay et al. 2003). Due to their disappearance from more southerly rivers, eulachon in the Columbia River probably represent the southernmost population that can reasonably be expected to respond to conservation measures.

The loss of either the Columbia or Fraser River eulachon populations would imperil the persistence of the taxon as a whole and cause major disruptions to associated ecosystems and communities. Both populations are significant in this respect. However, due to differences between the U.S. and Canada in the management and regulation of eulachon harvest and habitat, and lacking concrete evidence for further differentiation among individual populations that spawn in river systems located south of the international border, we recommend that NMFS classify these populations as a single, discrete group of populations, separate from those occurring further north, including the Fraser River. Further, because the loss of these Washington, Oregon and California populations of eulachon, in toto, would pose a significant risk to the long-term persistence of the species, we recommend that they be designated as a DPS. We suggest that this group of eulachon populations be referred to as the Southern Eulachon DPS.

Status of Southern Eulachon DPS

There have been no consistent, quantitative programs to directly monitor eulachon abundance over time in the Columbia River Basin or elsewhere. However, several indicators of annual eulachon run size are available for tracking the relative status of the species. Ideally, fisheries independent estimates of escapement, biomass, and larvae production would be used, but these statistics are not available. Despite the clearly depressed population status, there have been no efforts to increase and improve monitoring. Described below are statistics used as indicators of abundance, which are the same indicators used by the Washington and Oregon Fish and Wildlife agencies (referred to as the Joint Staff) to predict run size for management of harvest levels (WDFW and ODFW 2001, 2006).

Abundance

Commercial Catch

The most complete, long-term indicator of eulachon run sizes is the commercial harvest record from the Columbia River and its tributaries, which began in 1938. The recreational and tribal catches were not monitored, but in some years the combined values of these efforts were believed to have been as large as the commercial catch. While catch in each of the tributaries has been highly variable (as noted in NMFS' response to the original petition, each major tributary has had years when no eulachon were caught), the combined total harvest across the basin has consistently exceeded one million pounds (mp) annually until 1993. From 1938 to 1992, the median total commercial catch was approximately 1.9 mp, and only 4 of the 55 years had catches below 1 mp.

However, in 1993 and subsequent years, total commercial harvest has reached 1 mp only once (Figure 1). When the first petition was written, total annual catches over the prior 7 years had all been well under 1 mp. Despite optimistic increases in the early 2000s, smelt catches have since crashed again. In the 15 years from 1993 to 2006, only once did the commercial catches exceed 1 mp. The median catch during this time period has been approximately 43,000 pounds, 97.7% less than the median catch during the prior period.

Before the mid 1990s, harvest was a reasonable indicator of the number of smelt returning to spawn and thus abundance (Brad James, WDFW, personal communication). However, more stringent regulations on the fishery after the crash of 1994 have led to these data being less representative of total abundance (discussed below). Despite their limitations, more recent catch statistics still offer some relative indication of eulachon numbers. For example, it is clear that after a brief recovery in the early 2000s, eulachon catches are again extremely low.

A detailed discussion of the historical catch data, including pre-1900s, is included in the original petition (Wright 1999) along with important caveats to consider when interpreting these numbers. First, catch is not always proportional to abundance because market demand frequently dictated how many were caught. When eulachon run size was large, price per pound was low, and therefore fishermen had less incentive to keep fishing. When the run size was small, price per pound was high, leading to a greater amount of relative effort. This means that the smaller runs experienced the highest fishing mortality rate, and that catches actually portray less inter-annual variability than was actually present in run sizes. Second, it is possible that harvest regulations in recent years have limited fishing opportunity such that runs may be more abundant than catches indicate. This possibility is refuted below by comparing catch in relation to fishing effort.

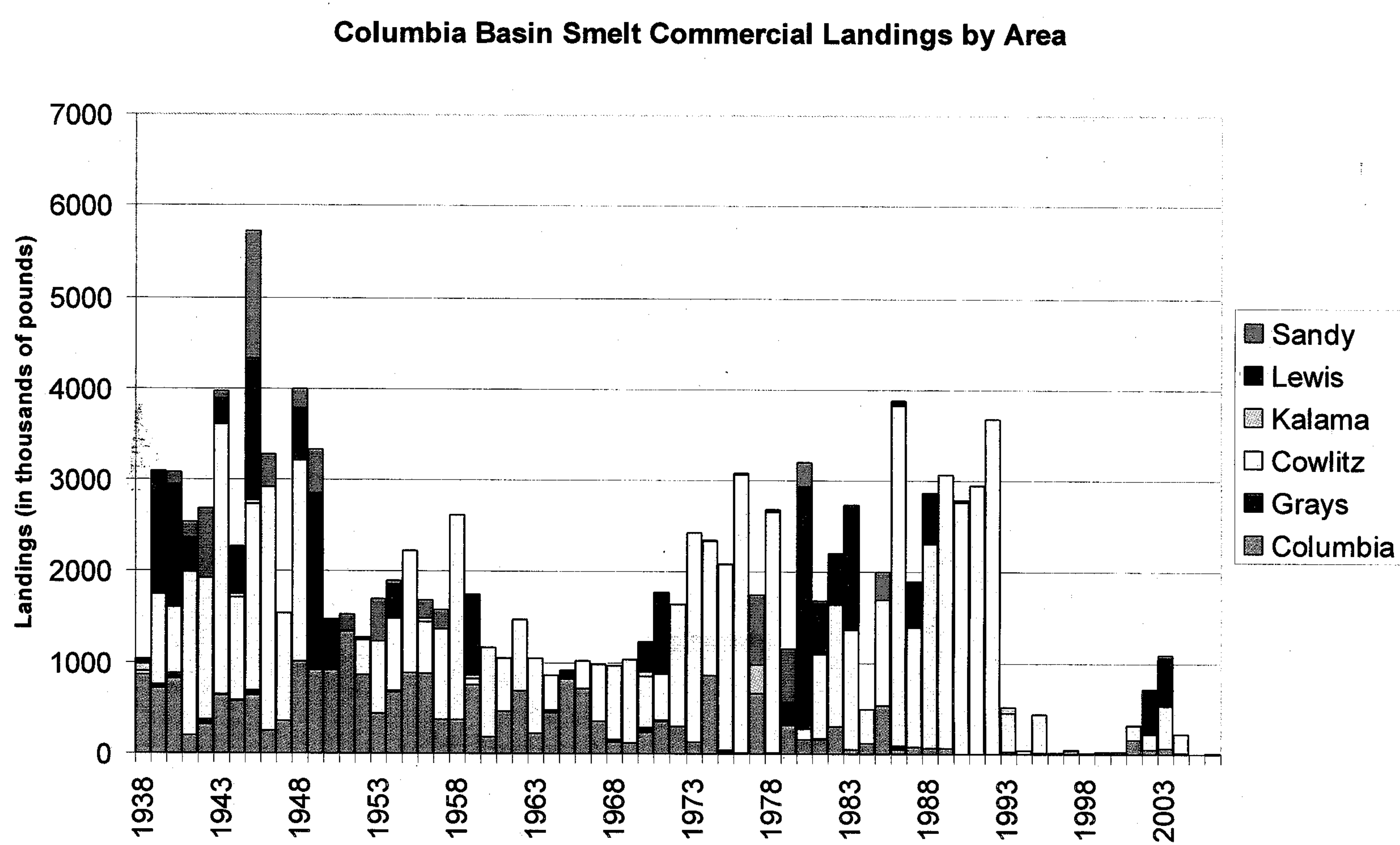

Figure 1: Total annual commercial catch from the Columbia River and its tributaries. Data from WDFW and ODFW (2001, 2006).

Catch per Unit Effort

One of the major criticisms of using the number of fish caught to estimate the number that are present in the system is that there is no way to tell how much effort was put into catching those fish. This is especially true in this case where lower catches would be expected as a result of the increasingly restrictive regulations on harvest, and not necessarily because of low abundances. To account for this, WDFW provides catch per unit effort (CPUE) data for the Columbia River commercial fishery from 1988 to 2006 calculated as pounds per delivery (figure 2) (WDFW and ODFW 2007). In general, the period from 1994 to 2000 shows that even when effort is accounted for, abundance still appeared to be very low. Despite the spike from 2001 to 2004, the last two years (2005 and 2006) show similarly low returns.

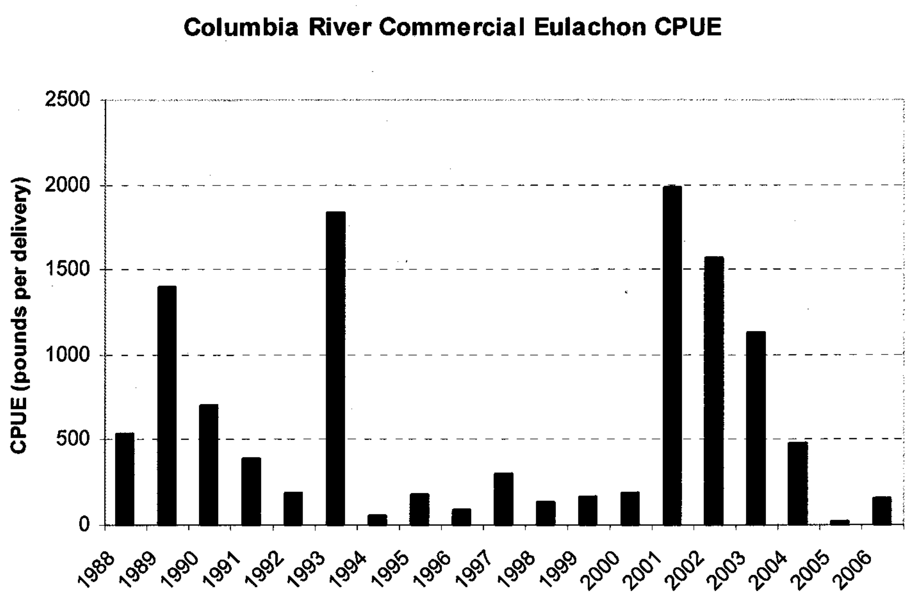

Figure 2: Annual commercial eulachon catch per unit effort from the mainstem of the Columbia River. Data from WDFW and ODFW (2006).

As noted in the joint management plan created by WDFW and ODFW (2001), CPUE from the test gill-net fishery may be a biased indicator of relative abundance under two circumstances. During periods of high abundance, nets become saturated with fish, such that they are no longer reflective of the total abundance available for capture. When eulachon abundance is low, fishermen wait until the fish have accumulated in an area before setting the nets, so that their CPUE remains artificially high (WDFW and ODFW 2001). Thus, similar to commercial catch statistics, CPUE can also underestimate the larger runs and overestimate the smaller runs, leading to less apparent differences and less cause for concern.

Larval Survey

A fisheries-independent method to determine annual abundance of eulachon in the Columbia River Basin involves larval surveys. These surveys provide another indication of the level of spawning activity; however, sampling effort and techniques have been inconsistent from year to year, which undermines their value for comparing between tributaries and/or years. Results are currently used by the Joint Staff to determine the presence or absence of spawning activity in tributaries when no smelt are captured in the fishery. The data are presented here for completeness and to show that despite methodological inconsistencies, relative larval densities, especially in the mainstem and Cowlitz, correspond with other indicators of abundance and confirm that the mid to late 1990s and mid 2000s have had extremely low production.

Certain changes to sample design and consistency between years could improve the value of this survey. In fact, the Department of Fisheres and Oceans (DFO, Canada) currently uses larval surveys to estimate spawning biomass in the Fraser River. This statistic has never been estimated for the Columbia River.

Table 1: Results from WDFW larval surveys. Data from WDFW and ODFW (2006). Color added: larvae/m^3<1 = blue; 1-10 = green; 10-100 = yellow; >100 = red; 0 = grey.

	Mainstem Columbia	Cowlitz	Grays	Elochoman	Kalama	Lewis	Sandy
1986	NS	[illegible]	NS	NS	NS	NS	NS
1994	NS	0.7	NS	NS	NS	NS	NS
1995	NS	19.7	NS	NS	32.4	NS	NS
1996	[illegible]	[illegible]	NS	NS	[illegible]	NS	NS
1997	[illegible]	[illegible]	NS	[illegible]	[illegible]	0.0	NS
1998	[illegible]	[illegible]	[illegible]	22.1	[illegible]	0.0	[illegible]
1999	[illegible]	[illegible]	0.6	[illegible]	[illegible]	0.0	[illegible]
2000	[illegible]	41.6	25.7	[illegible]	[illegible]	[illegible]	[illegible]
2001	42.1	[illegible]	24.4	0.0	[illegible]	17.6	NS
2002	28.2	[illegible]	NS	NS	[illegible]	[illegible]	NS
2003	12.3	[illegible]	NS	24.5	NS	36.2	[illegible]
2004	[illegible]	[illegible]	20.4	NS	NS	NS	NS
2005	[illegible]	NA	0.6	NS	NS	NS	NS
2006	[illegible]	[illegible]	0.0	NS	NS	NS	NS

West Coast of Vancouver Island Shrimp Trawl Survey

Shrimp trawl surveys conducted off the West Coast of Vancouver Island by the DFO have recorded relative densities of eulachon caught as bycatch since 1973. These catches include mostly 1- and 2-year old eulachon prior to their return migration and thereby represent a sampling of the biomass poised to return to spawn in the following 1-4 years.

As expected, this index correlated with future catches in the Columbia River (Pearson correlation coefficient = 0.551, p=0.005) (Hay et al. 2003).

Until the early 1990s the eulachon index was variable, but averaged around 1000 metric tons (mt). In the mid-to-late 1990s the index was consistently below 100 mt, but jumped to record levels (>4000 mt) between 2000 to 2004. The last two years of data show a return to mid-1990s values of less than 100 mt. Although some uncertainty remains regarding the reliability of these data, they represent yet another argument for the unprecedented low abundances that have occurred in recent years.

Ocean Conditions

A final, but important piece of information that is used to predict the general strength of eulachon runs in the Columbia Basin and thereby assess the population's status relates to ocean conditions. The Joint Staff uses the Pacific Decadal Oscillation (PDO) index and the Southern Oscillation Index (SOI, i.e. defining El Niño and La Niña events) from 3-5 years prior to make general statements about returning cohorts' survival during the larval/juvenile stage (WDFW and ODFW 2006). While there is general consensus that ocean conditions are very important to determining the character of nearshore marine ecosystems (Brodeur et al. 2005), direct, quantifiable links between coastal oceanography and the abundance of eulachon have not been identified. Warmer ocean conditions along the Washington coast, associated with El Niño events, are generally linked to less productive nearshore ecosystems via a reduction in the upwelling that brings nutrients into the photic zone and stimulates primary and secondary production. The limited supply of food is then believed to limit the survival of larval eulachon. Warmer waters may also extend the range of predators such as hake (*Merluccius productus*) that usually remain in more southern or offshore areas (Emmett and Brodeur 2000), adding an additional source of mortality for juveniles. Cold ocean conditions indicate active upwelling and a burgeoning base to the food web, leading to increased survival and ultimately, stronger returning eulachon runs 3-5 years later.

Variability and/or trends in ocean conditions are for the most part unpredictable and are not able to be manipulated by humans. This leads to confusion about the primary causes and consequences of population declines and what we can do (or cease doing) to restore them. Climate change models predict more frequently occurring El Niño events (Timmerman et al. 1999) and gradual warming of sea surface temperatures in the northeast Pacific. Therefore, over the long term, eulachon runs may not have the capacity to bounce back as easily as they have in the past.

Threats to the DPS

The Southern Eulachon DPS faces a combination of both natural and anthropogenic threats, although few of these threats have been quantified in terms of their direct effect on the population. Section 4a of the Endangered Species Act considers five main factors in determining whether a species warrants a threatened or endangered status. These factors and pertinent threats are discussed below.

1. The present or threatened destruction, modification, or curtailment of its habitat or range

The historic range of southern eulachon has been significantly curtailed over the last two decades. It is difficult to discern the significance of their occurrence in central California rivers, i.e. in the Sacramento River and further south, from anecdotal evidence (Minckley et al. 1986), but it is clear that regular, abundant runs, which were present at least in the Klamath River, Mad River and Redwood Creek, are now extirpated (Larson and Belchik 1998). The major extant component of the Southern Eulachon DPS is currently that which spawns in the Columbia River and it tributaries with perhaps intermittent contributions from spawning forays into Washington's coastal systems. Unfortunately, the stronghold of the Southern Eulachon DPS, the Columbia River Basin population, also appears to be at risk of extinction (see Population Status section), due in part to the destruction and modification of the habitat necessary for eulachon to successfully spawn.

The freshwater habitat required by eulachon for migration, spawning and egg incubation consists of clean water within a specific temperature range and coarse sand or gravel substrate. Hence, the cumulative effects of hydro-electric dams, industrial development and other shoreline modifications have served to reduce the quality and quantity of habitat in the Columbia River Basin.

Dams not only block access to a portion of this species' historic spawning grounds (in certain years eulachon were known to utilize the Hood River, now upstream of the Bonneville Dam) (Smith and Saalfeld 1955), they also artificially regulate flow timing and restrict the natural supply of coarse sediments. The original petition (Wright 1999) reviews the significant physical changes that have occurred in the Columbia River estuary as described in Sherwood et al. (1990). Flow regulation by dams also significantly impacts the Cowlitz River, the Columbia River tributary most consistently used for spawning by eulachon.

Eulachon are known to be sensitive to chemical pollution and avoid polluted waters when possible (reviewed in Wilson 2006). This reaction may impede or alter their normal distribution within the Columbia River Basin. Furthermore, when eulachon are exposed to contaminated waters, these contaminants become stored in their flesh, even though they do not feed during upstream migration. Contaminants from a wide array of industrial and agricultural sources throughout the Columbia River Basin have been a concern for decades, particularly in regards to their accumulation in fish and subsequent consumption by humans (US EPA 2002). While toxic organic compounds were shown to be highest in resident fish species, eulachon showed high levels of arsenic and lead (US EPA 2002). No studies have been conducted to determine whether contaminated eulachon have lower fecundity or other physiological responses that would directly threaten their population status, but these types of effects have been shown in other fish species (Kime 1995).

The most consistently used sub-basin, the Cowlitz River and in particular the Toutle River, has been greatly impacted by the eruption of Mount St. Helens in 1980 and the resulting Sediment Retention Structure (SRS) built by the U.S. Army Corp of Engineers. Releases of fine sediment from behind the SRS during the spring, when normally the river is clear, have been negatively correlated with Cowlitz River eulachon returns 3 to 4 years later (Lou Reebs, personal communication).

2. Overutilization for commercial, recreational, scientific, or educational purposes

The Columbia River eulachon fishery has traditionally been the largest throughout the species' range. Commercial fisheries have been as high as 5.7 mp and have averaged over 2 mp until 1993. Recreational and tribal components of the smelt fishery have not been monitored but may have been equivalent to the commercial catches. While it is impossible to estimate the fishery mortality rate without an estimate of the total run size or escapement, it is clear that fishing pressure has been significant.

Similar to other forage fish species, eulachon have highly variable productivity, which is likely related as much to environmental conditions as it is to the number of spawners, and over the past century, the Columbia River eulachon resource has been extremely resilient to unrestricted extraction. Therefore, fishing mortality alone is probably not why Southern Eulachon DPS is now threatened with extinction. Fishing mortality is, however, an increasingly important threat as the population declines and harvest levels need to be closely regulated based on biological information. As noted in the original petition (Wright 1999), if market forces are used to determine the annual harvest, a larger proportion of the total run would be caught when abundance is low and thus, the highest mortality rates would occur when the population is most susceptible to overfishing. The added mortality from fishing compounds and exacerbates the low points in the cycle of other natural and anthropogenic threats.

3. Disease or predation

The effect of predation on eulachon is important to consider, especially because of their role in the ecosystem. Eulachon are preyed on by myriad marine and freshwater species. This list includes fish such as white sturgeon, green sturgeon, spiny dogfish, sablefish, salmon sharks, arrowtooth flounder, salmon, Dolly Varden, Pacific halibut, and Pacific cod; birds such as harlequin ducks, pigeon guillemots, common murres, mergansers, cormorants, gulls, and eagles; and marine mammals such as baleen whales, orcas, dolphins, harbor seals, and Steller sea lions (Wilson et al. 2006). Generally, predation rates decline in response to lower prey availability, which minimizes the threat of predation leading to extinction, but because of the schooling behavior of eulachon and high value as a prey item, it is possible that they remain targeted even in years when relatively few return. Few quantitative studies have attempted to enumerate this effect, but a personal communication (Greg Bargmann, WDFW) cited in the original petition (Wright 1999) estimated that harbor seal consumption of eulachon in late 1980s was 335 tons annually. This equates to approximately 670,000 lbs. or about one quarter of the average commercial catch during this time period. No evidence suggests that disease is currently a threat to eulachon.

4. The inadequacy of existing regulatory mechanisms

In 2001 a eulachon management plan was created jointly by the states of Washington and Oregon (WDFW and ODFW 2001). This joint plan was formed under the authority of the Columbia River Compact and in response to the population decline in the mid-1990s and the increased concern following the ESA petition (Wright 1999). The joint management plan describes the relative indicators useful for predicting eulachon run size (primarily this includes the strength of the brood year spawning effort and ocean productivity) and outlines three levels of acceptable fisheries depending on the predictions. Level one represents the most conservative regulations when the run size is uncertain or expected to be poor. Fishing allowed under a level one fishery is primarily meant to provide a minimal harvest opportunity and consistent statistics at low stock sizes. Level two fisheries are allowed when productivity indices are promising but the actual run strength is still uncertain. When run strength indicators are very favorable, the most liberal harvest strategy, a level three fishery, would be allowed. Each year the initial fishery level is determined by the aforementioned indices and then modified in-season based upon harvest data from the on-going sport or commercial fisheries.

While this approach is probably the most appropriate given the lack of information on eulachon population dynamics and recruitment processes, the population has not recovered under its watch. As such, the existing regulatory mechanism appears to be inadequate to justify its continued use as the sole means of regulating eulachon catch. Despite the need for further fisheries independent monitoring and research, very few new programs have been implemented. The lack of pertinent information, such as escapement or biomass estimates, will continue to weaken the efficacy of management decisions.

5. Other natural or manmade factors affecting its continued existence

Many other factors, both natural and anthropogenic in origin, threaten the continued existence of the Southern Eulachon DPS. Climate change, susceptibility to non-target fisheries, and ecosystem changes all play a role in determining the future of this species.

In the marine environment, a further threat to eulachon is the mortality experienced from being taken as bycatch in trawl fisheries that target shrimp (Hay and McCarter 2000). Quantifying the total eulachon take in this fishery and determining the origins of these fish is difficult. Hay and McCarter (2000) use bycatch statistics from the Canadian shrimp fleets to estimate the scale of this threat and concluded that "although the shrimp trawl industry probably has not caused the recent decline in eulachons, we cannot rule out the possibility that it could be a factor in limiting the recovery of certain stocks." Gear modifications, such as excluder devices, have reduced mortality rates, but shrimp fishermen may still take significant numbers, especially in BC where eulachon are most abundantly distributed in marine waters.

Global warming, regardless of its cause, is likely one of the greatest threats facing the Southern Eulachon DPS. Because this DPS represents the southernmost extent of the species range, it is likely to be at a higher risk from continued warming trends than populations further north. Ironically, the same region that once served as a refuge during the last glacial cycle may soon be no longer habitable.

Requested Action

We petition the National Marine Fisheries Service, Department of Commerce to consider the evidence provided in this petition and otherwise available to a) define eulachon (*Thaleichthys pacificus*) that spawn in all U.S. rivers south of the international border with Canada, but primarily the Columbia River Basin, a Distinct Population Segment, and b) to list their status as threatened or endangered under the Endangered Species Act (16 U.S.C. §§ 1531-1534).

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